NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 3210 MIDTERM EXAM II 11/96 Prof. Powers

- This exam is open book and notes.
- There are three problems; each is equally weighted.
- Partial credit will be given; be sure to do some work on each problem.
- Be sure to include units in your answers.
- Please circle or underline your answers.
- Do *NOT* do any work on this sheet.
- Show *ALL* work.
- Enter your name in the space provided.

1	
2	
3	
Total	

Name: _____

A laser material with an index of refraction of 1.2 has the energy level diagram shown below. The transition from level 2 to level 1 is lifetime broadened.

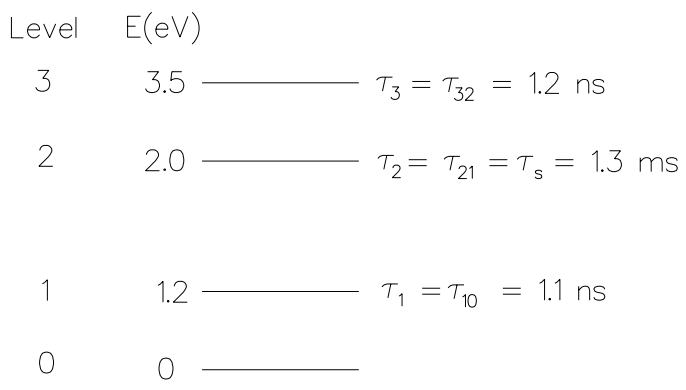

Figure 1: Information for Problems 1 and 2.

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1. Find the three Einstein coefficients for the radiative transitions between level 2 and level 1 for the material with the properties described above.

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2. Consider the material above. If the unsaturated gain coefficient, β_0, is 3,000 m^{-1} when $\nu = \nu_0$, find the (saturated) gain coefficient when the irradiance level in the material is 1,200 $\mathrm{W/m}^2$.

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3. A laser's optical gain medium (***NOT*** the one described above) operates at a wavelength of 1.06 μm, has an index of refraction of 1.5, and a length of 25 cm. If the left mirror of the laser is 100% reflecting and the output mirror transmissivity is 95%, the output irradiance of the laser is found to be 1% of the value of the saturation irradiance of the laser. The unsaturated gain coefficient of the material has a value of 5,000 m^{-1}. **(Added information: The given numbers in the problem give a T > 1. For a more realistic answer, assume that the output irradiance is 40% of the saturation irradiance when the output mirror is 95% transmitting and that the unsaturated gain coefficient has a value of 1 m^{-1}.)**

   Find the value of optimum reflectivity of the output mirror.